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Elena Aronova[*]

Abstract: *»Umweltmonitoring im Entstehen: Von der Übersicht über natürliche Ressourcen zur Beobachtung von Umweltveränderungen«*. This article examines the nexus of ecological science and environmental politics by considering the tensions between the global circulation of the *notion* of "environmental monitoring" and the local *production of data* on environmental change. The history of the planning of the Global Network of Environmental Monitoring (GNEM) program provides a glimpse of what it takes to launch a program of environmental monitoring *globally* on the level of intergovernmental organizations, such as the United Nations. The first part of the paper traces the GNEM project as it moved through different international agencies and international programs in the 1960s and 1970s. The second part explores the *local* story of the environmental monitoring of Lake Baikal. The emergence of "environmental monitoring" as an issue of *global* concern, and the *local* story of environmental monitoring of Lake Baikal were interrelated, but only in theory: Rather than boosting the already ongoing local monitoring of Lake Baikal, the intergovernmental global monitoring program was used as a legitimation to sustain the environmental pollution of the lake. Yet, the Soviet scientists-led environmental activism, which failed to influence environmental regulation in the Soviet Union, had critically contributed to the sustaining of the environmental monitoring programs in a small way, through collecting the data detailing the environmental changes in the places most affected by disastrous Soviet environmental policies, such as those regarding Lake Baikal.

Keywords: Environmental history, Soviet history, international biological program, Global Network for Environmental Monitoring (GNEM), Lake Baikal.

1. Introduction

In 2008, the journal *Global Change Biology* published an article documenting the warming of surface waters and the long-term changes in the food web of the world's largest freshwater lake, Siberia's Lake Baikal (Hampton et al.

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2008). The study, conducted by a team of Russian and American scientists at the National Center for Ecological Analysis and Synthesis at the University of California, Santa Barbara (NCEAS), contributed important data to the growing evidence on global warming. The most remarkable, however, was the data set itself, collected for over 60 years by a single family of Siberian zoologists. From roughly 1945, three generations of limnologists – Mikhail Kozhov, his daughter Olga Kozhova, and her daughter, Kozhov's granddaughter, Lyubov Izmest'eva – dutifully recorded a series of physical and biological parameters, including water temperature, clarity, and its chemical composition, at the same specified site on Lake Baikal. The data collection scheme had a very high resolution: sampling was done every seven to ten days with samples collected at 500, 250, 200, 150, 100, 50, 25, 15, 10, 5, and 0 meters (Breining 2011). The data collection program was pursued without interruption throughout Stalin's regime and Khrushchev's Thaw, Brezhnev's "stagnation" and the dissolution of the Soviet Union. The outcome was thousands of meticulously recorded data. The *New York Times* featured a story about the study, stressing that a "family science project" yielded "physical and biological data […] of inestimable scientific value" (Dean 2008). Sociologists picked the story to highlight the sociological dimensions of quantification (Espeland and Stevens 2008). At home, Kozhov had been praised as a "precursor" of environmental monitoring who "30 years before not only the organization of environmental monitoring programs, but even before such a notion ever existed, had launched the environmental monitoring of the Lake Baikal ecosystem."[1]

Why are such data so rarely found? *Are* they rarely found? Regular and systematic data collection about natural systems can be traced back to medieval monks taking monthly temperatures. Compilations of data on weather conditions, such as temperature, winds, precipitation, and humidity, became available for many parts of the world from the 1870s. The first limnological surveys – surveys of lakes – also go back to around the same time, although the systematic and regular scientific programs for monitoring the environment of lakes, such as the monitoring program for Lake Geneva in Switzerland, or the Great Lakes in North America, were only started in the 1950s.[2] The word *moni-*

[1] <http://old.rgo.ru/2010/09/zavershilis-chteniya-pamyati-m-m-kozhova> (Accessed April 24, 2014).

[2] Thus, the Lake Geneva monitoring survey (managed by the International Commission for the Protection of Lake Geneva Waters and the INRA, French National Institute for Agricultural Research) was started in 1957 (Berthon et al. 2013). In the US, although some fish production data are available for as early as 1867, general fishery and limnological surveys were made at Lake Michigan in 1951, 1952, 1954, 1955, 1960, and 1961; Lake Huron in 1952 and 1956; Lake Superior in 1952, 1953, and 1956; and Lake Erie in 1957 and 1958. Besides the US Bureau of Commercial Fisheries, which oversaw these surveys, several organizations participated in these data collection activities, such as the Great Lakes Research Division of the University of Michigan of the US Fish and Wildlife Service, and the Ohio Division of Shore

toring has a military ring to it, and for good reason, indeed. After WWII, the military became keenly interested in monitoring the physical environment on a global scale, and developed, in the words of Jacob Hamblin, "the largest data collection network in history" (Hamblin 2013, 87).[3]

However, these data are barely used by biologists today. The early lake monitoring programs, run by fisheries agencies, had low-resolution sampling protocols, collecting data only once every month or two. The military-supported environmental research, on the other hand, produced data that were either classified or buried in reports that have not been widely accessible. Many ecologists feel that "the use of archived data, especially from before the 1970s, can be compromised by the heterogeneous nature and uncertain quality of older biological and chemical records […] Poorly designed monitoring programs, unable to answer the questions they were designed to answer because of inadequate sampling strategies, led to poor detection capability" (Clarke et al. 2006).

Historical data can be used, of course. For instance, historical data are critical to the study of climate change. Yet, the publications in the journal *Limnology and Oceanography* demonstrate that the data sets comparable in resolution and quality to the one collected by the Siberian family are mostly found only starting in the 1970s and onwards. Certainly, in the 1970s, a wider access to increasingly powerful computers and a potent new tool, computer modeling, stimulated long-term monitoring studies, but above all, as a target of research and a notion in the public sphere, "environmental monitoring" was boosted by the environmental movement of the late 1960s, and in this sense is the product of the era of DDT, napalm, and Agent Orange. The familiar story of the rise of the "new global environmental consciousness" starts with the publication of Rachel Carson's *Silent Spring* in 1962 and ends with the United Nations 1972

Erosion. Outgrowths of these surveys were the "index stations" established to collect a broad spectrum of water quality and biological data (Lewis 1984, 147).

3 As many historical studies have demonstrated, from the 1950s until the 1970s, environmental monitoring loomed large on the radar of military strategists in the US (Doel 2003; Oreskes 2003; Oreskes and Doel 2002; Oreskes and Rainger 2000; Rainger 2000a, 2000b; for the most recent account see Hamblin 2013). The accounts of the Soviet military's involvement in support of environmental studies, although still very incomplete, also point to a significant military involvement in earth science research, especially after WWII (for a general overview see Bystrova 2006; Aronova and Oreskes 2010). In both cases, however, the military were mostly interested in assessing the physical environment in the domains deemed important to the operational needs of the military agencies that supported it: oceanography, seismology, radiology, meteorology, and some other geophysical disciplines. As historian Ron Doel pointed out, "most of the biological sciences (save for toxicology, physiology, and radiation ecology) were far less affected by military patronage in the Cold War" (Doel 2003, 639; for the military interest in forming a comprehensive environmental picture about such big areas as the entire Pacific, which would include both physical and biological conditions, see MacLeod 2001).

Conference on the Human Environment, highlighting these two events as the markers of a decade-long watershed in the perception of the environment.[4]

This is, at least, how the Anglo-American story goes. In the English-speaking context, the very term "environment" only emerges as the center of the environmental political movement in the 1960s. Is it generalizable to other countries and national cases?[5] Have biological environmental monitoring data collection programs been generally tightly linked to political environmental movements? The Russian case apparently suggests otherwise: While the Soviet Union's environmental legacy is notorious for the catastrophes of Chernobyl and the Aral Sea, the nuclear poisoning of the southern Urals and of eastern Kazakhstan, as well as the host of other serious environmental disasters, Soviet environmental activism did not leave any visible legacy and in any case was not influential or effective (Weiner 2006).[6]

In this article I seek to extend the familiar story of the nexus of ecological science and environmental politics by introducing a much needed comparative dimension, and by examining the tensions between the global circulation of the *notion* of "environmental monitoring" and the local *production of data* on environmental change. I use the history of the planning of the "Global Network of Environmental Monitoring" (GNEM) program in the late 1960s and early 1970s to provide a glimpse of what it takes to launch a program of environmental monitoring *globally*, on the level of intergovernmental organizations, such as the United Nations. In the first part of the paper I follow the planning of the GNEM project as it moved through different international agencies and large-scale international programs. Then I follow the *local* story of Kozhov's family project of the environmental monitoring of Lake Baikal, asking: What was the motivation to start, and sustain, the effort to keep track of environmental change, locally and globally? I show how the *global* story of the emergence of "environmental monitoring" as the issue of concern and the focus of research, and the *local* story of Kozhov's family project of the environmental monitoring of Lake Baikal started a decade earlier, were indeed interrelated, but only on paper: Rather than boosting further the already ongoing local monitoring of Lake Baikal, the intergovernmental global monitoring program was used as a legitimation to sustain the environmental pollution of the lake.

4 It also marked a break with the most recent past in the sense that the large-scale studies of the environment started to grow exponentially outside the military realm, and, with it, the ecologists' distrust of the approaches of physicists tainted by their association with the military (for an overview and discussion see Doel 2009; Dörries 2011).

5 See Bess (2003) for the history of the French environmental movement as distinct from the British and American ones in its embracement of the apparently antagonistic pro-nuclear technology arguments and sentiments.

6 See also Weiner (1999) on the history of nature conservation in Russia and the Soviet Union.

In a sense, looking at the familiar story of environmental movement by following its "data track" does not make this story less familiar, but it adds interesting twists to it. Both locally and globally, as I discuss below, environmental monitoring programs had emerged at the crucial nexus of ecological science and environmental politics. In both cases, the data collection began with one imperative – *surveying* nature (e.g. measuring environmental parameters in relation to *space*) – then shifting the focus to *monitoring* the changes in the environment (i.e. measuring the environmental parameters in relation to *time*). In both cases, behind the shift from *surveying* to *monitoring* were specific abuses of nature and the shift in the perception of nature as something that can be used, controlled, or transformed, to something that is threatened, polluted, or otherwise *changed.* Lacking a Russian counterpart to Rachel Carson's *Silent Spring*, the Soviet scientists-led environmental activism, which failed to influence environmental regulation in the Soviet Union, had, nevertheless, critically contributed to the promotion and sustaining of the environmental monitoring programs in a small way, through collecting the data detailing the environmental changes in the places most affected by disastrous Soviet environmental policies, such as those regarding Lake Baikal.

2. Environmental Monitoring in a Big Way: The Proposal for Establishing the "Global Network of Environmental Monitoring" (GNEM)

In 1968, a group of ecologists actively involved in the International Biological Program (IBP 1964-1974) came up with a proposal for the Global Network of Environmental Monitoring (GNEM). The IBP, an international effort of coordinated large-scale ecological and environmental studies, was then halfway through its operations. The official theme of the IBP was "The Biological Basis of Productivity and Human Welfare," with its official aim of producing a worldwide survey of "(a) organic production on the land, in fresh waters, and in the seas, and the potentialities and uses of new as well as of existing natural resources, and (b) human adaptability to changing conditions" (Worthington 1983, 165).[7] In the planning of the IBP, "biological productivity and human adaptability" were to be surveyed and assessed by the many biological specialties represented in the IBP: biogeography and human geography, physiology and genetics of plants, animals, and humans; variations in the physics, chemistry, and biology of the environment affecting living organisms; the representation of ecosystems as mathematical models; and so on. The scope of the pro-

[7] For the history of the IBP in general see Appel (2000); Aronova, Baker and Oreskes (2010); Golley (1993); Hagen (1992); Kingsland (2005); Kwa (1987, 1993); Waddington (1975).

gram was all-encompassing: The atmosphere, the hydrosphere, the biosphere, and the lithosphere were all in the picture. Most of all, the focus on biological productivity and the Earth's biological resources implied the collection of basic physical and biological environmental data on a global scale. And this was the goal of the IBP.

Surveying "biological productivity" did not necessarily imply *monitoring* these parameters on a regular and continuous basis. Modeled after the International Geophysical Year (IGY, 1957-8), the biological version of the IGY, initially called the International Biological *Year*, was conceived as an extension of the geophysical description of the Earth to include its living components.[8] In contrast to the IBP, the GNEM was designed explicitly as a long-term project – virtually the opposite notion of a biological "year."

The first occurrence of the wording "global environmental monitoring network" in the records of the minutes of the US Scientific Committee of the IBP is found in relation to the discussion of "data exchange" and the planning of the "synthesis and transfer" of the IBP activities to other organizations after the termination of the program. The US IBP Committee recommended "that the U.S. take the initiative [for developing the *global monitoring network*] by establishing a working group including those with special talents in data handling to develop mechanisms for promoting data exchange."[9]

It was, however, not an American but a group of Scandinavian scientists, led by Swedish zoologist Bengt Lundholm, that took the lead in envisioning and lobbying for the GNEM project. Lundholm was a mammalogist who, after working at the Transvaal Museum in Pretoria, South Africa, moved into eco-policy planning and held various policy planning positions in Sweden (Büttiker-Otto 2008). As secretary of the Ecological Research Committee of Sweden's Natural Science Research Council, Lundholm became involved in the planning of the Swedish participation in the IBP. Backed by other Scandinavian IBP participants, Lundholm insisted that the IBP should concern itself with the urgent problems of the environment, expanding the IBP theme, "biological productivity," with its *surveying* imperative, to address the environmental issues by *monitoring* global and long-term environmental changes (Worthington 1983).

On the initiative of the Scandinavian group within the IBP, the proposals to monitor the global changes in the environment were discussed at the 3rd General Assembly of the IBP in Varna, Bulgaria, in April 1968 (Worthington 1975, 111). As a result, a three-man *ad hoc* committee for the "Global Network for

[8] See the discussion of the "genealogy" of the IBP in Aronova, Baker and Oreskes (2010). Although it was soon realized that the idea of the "International Biological Year" was too limited, and the program started as a five-to-seven-year IBP, the original impetus of "surveying the web of life" was kept throughout the program's planning and realization.

[9] Minutes of USNC/IBP meetings, 25-27 September 1969. USNC/IBP: Meetings: Minutes: 25-6 September 1969 (emphasis added by EA). IBP Papers, National Academy of Sciences Archives, Washington DC (hereafter IBP Papers).

Environmental Monitoring" was appointed by the Assembly, to examine the need for and feasibility of such a network.[10] The Committee consisted of American zoologist W. Frank Blair, the chairman of the US National Committee for the IBP; Soviet limnologist Nikolai Smirnov, a member of the Soviet National Committee for the IBP; and Lundholm, as a representative of the Swedish IBP Committee. The Committee was dubbed the "Lundholm-Blair-Smirnov committee for global monitoring" (Malone 1971, 63).

The tripartite composition of the GNEM Ad Hoc Committee was a tactical decision. During the Cold War, international scientific cooperation became an arena of competition for moral superiority, and the "globalization" of environmental data was an ideal showcase for each superpower's willingness to collaborate toward a common good (Agar 2012, 334-7). In practice, it meant a lot of diplomatic maneuvering. In a letter discussing the "GNEM business" in preparation for the Committee meeting in 1970, Russell Stevens, a member of the IBP evaluation committee, gave a succinct testimony of the tensions behind these meetings:

> I hope those concerned [with GNEM] will think very carefully about the political implications of the proposed tripartite meeting. [...] I think the arrival of the US member of the group, armed with a 100-page report and backed up by an additional person, could easily be interpreted by the other two – and of course primarily the Soviet member – as an effort to impose the US position upon them, even though polite protests to the contrary were made. On the other hand, if all three arrived with 100-page reports, the chances of getting a unified document [...] would be mightily slim.[11]

Not coincidentally, the Swedish member had always been in a chairman's position in the GNEM commission, serving as a mediator between the representatives of two superpowers. Sweden also became the chosen site for a series of meetings devoted to discussing the GNEM planning. The Ecological Research Committee of the Swedish Natural Sciences Research Council sponsored the planning meetings, beginning with a pilot research assessing the feasibility of the GNEM. A working group was appointed, with Lundholm as chairman, and Swedish biologists E. Eriksson, L. Hannerz, H. Holmen, A. Johnels, A. Lindroth, H. Sjors, and S. Svensson as members of the GNEM planning team.

The result was the Swedish proposal "Global Baseline Stations," which emphasized the "urgent need to create a kind of an early warning system based on a long-time series of environmental data from strategically situated stations or sampling areas."[12] The global coverage did not imply a large number of sta-

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[10] Frank Blair to Murray Todd, 12 March 1969. USNC/IBP, IBP General 1964-1970, IBP Papers.

[11] Russell B. Stevens to Richard Oliver, 17 July 1970. USNC/IBP: Task Forces: GNEM: Ad Hoc General 1970. IBP Papers.

[12] Lundholm, Bengt: Global Baseline Stations: A global Network for Collecting Data on the Natural Environment, December 1969. USNC/IBP, IBP General 1964-1970, IBP Papers.

tions. The crucial requirement was the equal distribution of monitoring stations around the globe, and, most importantly, in less developed countries of the "Third World": Africa, South America, and Asia. The baseline stations were to be located in areas with the minimal level of human disturbance of the environment, in order to establish the background level against which the changes of various environmental parameters could be measured and calibrated:

> The network should consist of a system of nationally based stations or sampling areas. A nation or a group of nations has the responsibility for a particular station. The activities of the station are based on an international agreement and the cooperation between the stations is directed by an international agency with an executive headquarters. This headquarters is responsible for dissemination of data to all interested parties from governments to scientific bodies. […] The global baseline station may be part of a national or regional network with a similar programme as the global network or a programme to deal with special national or regional problems. The global stations may thus be the connecting links between different national networks. The important thing is, however, that the methods applied at the global stations are identical, which facilitates calibration between different national techniques.[13]

Lundholm's proposal was followed by American and Soviet reports. The Soviet report was prepared by the Committee that included evolutionary biologist Nikolai Vorontsov, future Environment Minister in the last government of the USSR under Premier Gorbachev; a forest scientist, Aleksandr Molchanov; a limnologist, Nikolai Smirnov; a soil scientist, Anatoliy Tyuryukanov; and a zoologist and ecologist, Stanislav Schvartz. Their report informed the assembly that the Soviet IBP National Committee had established a special Soviet national committee on "global biological baseline stations," which was formed and approved in April 1969. The report reassured the IBP assembly that Soviet biologists had a "positive opinion [...] on the foundation of the global network of baseline biological stations [...] having in mind that the creation of this network requires further decision by governments and UNESCO."[14] As the Soviet report emphasized,

> no existing institution is able to perform the whole of the observation programme for baseline stations. Which definite scientific institution will function as baseline station and [the] financing of these activities is to be decided in the further course of the organization of the network of these stations.

Lundholm's 1969 proposal was then extended into a publication (Lundholm and Svensson 1970).

[13] Ibid.

[14] "The opinion of the USSR committee of biologists on the global network of baseline biological stations," by the Soviet Committee of Biologists: Drs. N. N. Vorontsov, A. A. Molchanov, N. N. Smirnov, A. N. Tyuryukanov, S. S. Schvartz. July 1969. USNC/IBP Meetings: Background Material: 25-26 September 1969, IBP Papers.

In the meantime, "some biological bases [could be] transformed into the baseline stations" and other existing national and international networks, "such as hydrometeorological services, natural reserves, water and fish services" etc., could also be used as part of a "global network" of monitoring stations.[15] In the accompanying letter, Smirnov insisted that the activities on the organization of global baseline stations would involve countries "beside the USA, Sweden and the USSR," such as South Africa and "other developing countries."[16]

In the US, W. Frank Blair, the chair of the US National Committee for the IBP, headed the "Task Force for Global Monitoring," consisting of Glenn Hilst, Edward Goldberg, David Menzel, Thomas Malone, Ruth Patrick, William Gusey, Dale Jenkins, Helmut Lieth, William Murray, G. D. Robinson, and Robert Rowland. The "Task Force" organized a series of conferences at the end of 1968 and beginning of 1969, exploring the possible strategies for pursuing the project. Five working groups focused on "soil, water, atmosphere, surveillance and data handling, and biological parameters."[17] The American team estimated that the minimum number of stations could be actually "as low as twenty," assuming that the stations would be distributed among the main biomes in different continents (Lundholm 1971).

At this point of planning, however, Blair suggested transferring the GNEM proposal to another agency. Precisely because of the GNEM's estimated long duration and, hence, high expenditure, it surfaced as a program "at a level only possible through governmental and intergovernmental agencies" (Worthington 1975, 111). When, at the end of 1969, the ICSU established the Scientific Committee on Problems of the Environment (SCOPE), this became an occasion to transfer the GNEM planning from the IBP to the newly formed committee. The "Lundholm-Blair-Smirnov committee for global monitoring" continued as the "SCOPE Commission on Monitoring," which was chaired by Lundholm and included Blair and Smirnov as its members, joined by four other ecologists: W. Gallay and R. E. Munn from Canada, K. Grasshoff from West Germany, and V. N. Kunin from the USSR.

The first meeting of the SCOPE Commission on Monitoring in Madrid in September 1970 confirmed the plans to initiate the "investigations into the methodology of monitoring [...] and [...] the design of an integrated, appropriate broad-based monitoring system for air, water, soil and biota, including man." (SCOPE 1971) The Commission proclaimed that its objective was "to assemble, review and assess [...] the information available on environmental changes in the global environment," and to make collections of data and mate-

15 Ibid.

16 Ibid.

17 Blair, W. Frank: Interim report on the need for a global network for environmental monitoring, USNC/IBP Meetings: Background Material: 25-26 September 1969, IBP Papers.

rial for subsequent back reference, through the development of a "global network" of monitoring stations throughout the world (Fenner 1979).

When SCOPE was established, for the outsiders it looked hardly more than adding "still another acronym to a rapidly growing flora of governmental and nongovernmental bodies concerned with the environment." (Rosswall 1979) Lundholm was aware that "SCOPE possesses no executive authority and cannot require any environmental agency to *do* anything," even though he tried to present this as an advantage, arguing that since

> SCOPE has no particular 'axe to grind' <with anyone>, representing as it does the views of the world's scientific community, it is likely that the recommendations will be credible and acceptable to world governments and intergovernmental agencies in the UN as an unbiased estimate of what the real environmental problems are likely to be, now and in the future (Lundholm 1971).

Although this was way too optimistic a view, the SCOPE Commission on Monitoring did succeed in putting "environmental monitoring" on the agenda of the United Nations, making it eventually a household name.

The moment for SCOPE came when it was commissioned to provide expert scientific advice for the planned UN 1972 Conference on the Human Environment, and, later, for its institutional product, the United Nations Environment Programme (UNEP). Taking up the opportunity, Lundholm actively promoted the idea of a global coordinated environmental monitoring data collection program, and the UN Conference on the Human Environment approved plans for an extended global environmental data network "with little discussion" (cited in Edwards 2001, 49). The adopted "action plan" endorsed "the idea of a worldwide linkage of national and regional environmental monitoring networks," praising it as "exciting and challenging" (Munn 1973).

The UN 1972 Conference on the Human Environment is recognized as the first major intergovernmental discussion on the system of measures to ensure monitoring of environmental change on a planetary scale. The Conference's recommendation moved environmental monitoring from the realm of science to that of regulation and intergovernmental negotiations. The UNEP became the institutional body in charge of "coordinating and stimulating international monitoring activities especially at regional and global levels." (Gwynne 1982) Since 1975, the UNEP's Programme Activity Centre, with its headquarters in Nairobi, Kenya, has coordinated the two components of the UN environmental monitoring programs: Earthwatch, the environmental assessment component, and the Global Environment Monitoring System, or GEMS, the environmental monitoring component.[18] In contrast to its acronymic predecessor, the GNEM, GEMS programs only covered a limited number of environmental sectors/themes, such as freshwater quality, urban air pollution, and food contami-

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[18] See the review of the development of Earthwatch prepared for the UNEP Annual Report 1992 at <http://yabaha.net/dahl/earthw/annrpt92.htm> (Accessed April, 18, 2014).

nation (Munn 1973). Furthermore, the UNEP was unable to secure adequate funding to ensure either their long-term operation or global coverage.

The Soviet Union was an active participant in the global UN initiatives, and one of the largest donors to the Environment Fund of the UNEP.[19] In the Soviet bloc, the realization of GEMS initiatives officially began in 1977, when the State Committee on Hydrometeorology and Environmental Monitoring was appointed by the USSR's Council of Ministers as the coordinator of the "Global System of Environmental Monitoring" on the territories of the COMECON countries.[20] Among the many institutes listed as participants in the GEMS program on the territory of the Soviet Union was the Limnological Institute of the Siberian Division of the Soviet Academy of Sciences. The assignment for the Limnological Institute, as explained in the "Detailed program of scientific and technological collaboration on the problem of the 'Global System of Environmental Monitoring,'" was to provide "the selection and unification of the methods of observation of the meteorological, hydrological and other parameters that characterize the environmental conditions on the baseline and regional stations."[21]

The Limnological Institute was the new name for what was formerly Baikal limnological station. Kozhov's monitoring program had been pursued there. Kozhov's daughter, Olga Kozhova, was, like her father before her, a professor at the nearby Irkutsk University and a leading researcher at the Baikal station at the time of the launching of the GEMS. Lake Baikal's monitoring program appeared a perfect candidate for one of the GEMS baseline stations. And in-

[19] The Soviet bloc had boycotted the UN 1972 Conference, as a protest against the participation of the FDR. However, these objections did not impede the Soviet Union's later participation in the UN environmental governing bodies and politics. Paying the bills was one of the ways to exert their influence and the USSR paid generously. According to an environmental policy analyst, "On average, the Soviet Union contributed approximately $7.3 million a year to UNEP's Environment Fund from 1975 to 1991. Soviet contributions accounted for 12.1 per cent of the Environment Fund during that period. By comparison, the United States contributed 28.6 per cent of the Environment Fund during the same time, the United Kingdom 5.7 per cent, and France 4.0 per cent" (cited in Johnson 2012, 145). The objections by the Soviet Union and the GDR to the presence of the FDR were made routinely. Usually an exchange of letters would occur between embassy officials representing East and West Germany, formal statements would be made and the UNEP would duly note the objections in the report, to be forgotten until the next meeting (Johnson 2012).

[20] Resolution of the Presidium of the Academy of Sciences, 28 July 1977, in: "The working plans, reports, etc., about the participation of the Institute of the atmosphere's physics (IFA) in the 'Global System of Environmental Monitoring,' 1977-1981." Archives of the Russian Academy of Sciences (hereafter: ARAN), f. 2020, op. 1, no. 177, 1.

[21] "Excerpt from the 'Detailed program of scientific-technological collaboration on the problem of the "Global System of the Environmental Monitoring"' for 1977-1980", 31 September 1977, in: "The working plans, reports, etc., about the participation of the Institute of the atmosphere's physics (IFA) in the 'Global System of Environmental Monitoring,' 1977-1981." ARAN, f. 2020, op. 1, no. 177, 1.

deed, “baseline station Baikal” has been one of the nodes in the GEMS’s global net since the 1980s – but not the Kozhov data, though.

3. Environmental Monitoring in a Small Way: The Battle over Lake Baikal

Lake Baikal occupies a special place in the Russian cultural landscape. Since the nineteenth century, Baikal has belonged to Russian cultural memory as much as to Russian natural history. The first literary descriptions of the beauty and wildlife of the region were penned by the Decembrists sent into exile and penal servitude in Siberia. These forced “eyewitnesses” created a colorful picture of Baikal in their memoirs, recollections, and letters. Decembrist G. S. Baten’kov wrote of his experience:

> I was swimming across the waters of Baikal, traversing great expanses, observing nature in all its grandeur. […] Everything makes you thoughtful and wakes up some special, ineffable feelings in you: being extraordinarily remote from the centre of our fatherland, very few permanent residents, wild nature, fishermen’s huts scattered everywhere, white sails of ships seen in the distance – and the thought that somewhere behind the waters, behind the high mountain ridges, the land starts which differs from everything we have seen before, differs by the way of life and the people’s way of thinking (Karnyshev 2011).[22]

Many others have expressed their awe in art and in literature. Kozhov was one among many others who fell under its spell, making Baikal his lifelong passion, in his own way. Mikhail Mikhailovich Kozhov was born in a small village in the Irkutsk region of Siberia to a poor peasant family in 1890.[23] Self-taught, he received a teaching certificate in 1913, but then was mobilized in 1914 to serve in Poland during the First World War. After he returned in 1918, in the midst of a civil war, he was forced to serve in the White Army, and then, after he deserted three months later, he was mobilized again, now serving in the Red Army. Finally discharged in 1921, 30 years old, he decided to return to school, entering the Biology Department at the University of Irkutsk, 70 kilometers to

[22] Baten’kov was also the co-author of M. M. Speransky’s charter of native Siberian people, *On the Administration of Non-Russians in Siberia* (1822), under which the northern tribes of the Russian empire were allowed to carry out administrative and judicial functions by non-Russian councils and tribal administrations. The radical transformations of the empire’s political constitution went, however, much further than Speransky, and other liberal reformers associated with the Decembrists, intended. Whereas before, the native nomads of Siberia had been considered as such, they were now relegated to an artificial “settled” category and put on the same level as Russian settlers. This freed large sections of land up for cultivation while putting Siberian natives in a condition of destitution because of the increase in tax they now had to pay (LeDonne 2003).

[23] I owe much of the biographical and historical details on Kozhov to Josephson (1997).

the west of Lake Baikal. After graduating in 1925, Kozhov joined the newly opened Biological-Geographical Institute of Irkutsk University, quickly acquiring authority among the faculty and research fellows. He studied the flora and fauna of streams around Lake Baikal and the Angara river, and published his first book, *The Fauna of Lake Baikal, its Distribution and Environment*, in 1931. He was awarded his Kandidat Nauk degree (PhD) without defense in 1935, and in 1937 received his Doctor of Science degree (Habilitation) on the basis of his study of "Mollusks of Lake Baikal" (Josephson 1997; Sobennikov 1990).

It is difficult to reconstruct precisely what the initial incentive for Kozhov to start tracking the lake's ecological changes was. The recollections of Kozhov's family members give a hint, pointing out that the goal was to estimate and prognosticate the food resources for Baikal's fish and its dynamics (Breining 2011). Indeed, that would be a plausible rationale for the years of major famine in the Soviet Union in 1946-7, as a result of the war, and a severe drought in Moldavia, most of Ukraine, and parts of the central Black Earth and lower Volga regions. Kozhov started to record the lake's physical and chemical parameters, and to collect samples of the lake's zooplankton and phytoplankton, to assess the food resources for fish. He also started to take snapshots of the entire lake every year, launching circum-Baikal expeditions that took samples twice a year at 69 fixed locations. In addition, to examine the Baikal area's fish resources, he organized several expeditions to other lakes in East Siberia (ibid).

Certainly, Kozhov was not the first one who undertook the study of Baikal's resources. The first naturalistic account of Baikal goes back to the eighteenth century, when Peter the Great invited German physician, naturalist, and geographer Daniel Gottlieb Messerschmidt to Russia's newly founded Academy of Sciences. With the task of "collecting rarities and medicinal plants" from Siberia, Messerschmidt set out in 1720 on an exploration that took him seven years to complete. He made numerous observations on the ethnology, zoology, and botany of the region, excavating, for instance, the first known fossil mammoth remains. Messerschmidt also explored Lake Baikal, and made maps and charts of the lands around it (te Heesen 2000; Egerton 2008).

Modern research of Lake Baikal began in the nineteenth century. The first systematic study of the lake's natural environment was done by Benedikt Dybowski, a Polish zoologist and nobleman exiled to eastern Siberia for his participation in the Polish Uprising of 1863 (Borucki 1942). With the support of the Eastern Siberia Division of the Russian Geographical Society, Dybowski began to study the fauna of the Baikal region, measuring variations in the level and temperature of the lake. His program of observations included coastline studies, depth measurements, bottom and water sampling for chemical analyses, and water temperature and transparency measurements (Laptev 1939). Simultaneously, as part of the observatory movement that came to Russia later than in other empires, 11 hydrometeorological stations were set up in the lighthouses of Baikal between 1896 and 1901 by the first director of the Irkutsk Geophysical Laboratory, A. V. Voznesensky, who also started to record routine meteorological observations of Lake Baikal (Josephson 1997).

A major boost for Siberian explorations came during the First World War. The war cut Russia from its traditional suppliers of chemicals for gunpowder, iron, and other strategic resources. To find a way out of the crisis, a special commission was established for the systematic and thorough assessment of Russia's own natural resources – the Commission for the Study of Natural Productive Forces, or KEPS. KEPS, in turn, established a Baikal Commission in 1916, headed by academician N. V. Nasonov. That same year, Gleb I. Vereshchagin, with the support of the Russian Geological Society, established the Lake Baikal Limnological Station on the shore of Lake Baikal in Bolshiye Koty settlement, and became its first director. When, in 1923, the Biological-Geographical Institute opened its doors in Irkutsk, the studies of Baikal became firmly institutionalized (Josephson 1997).

From its inception, research at Baikal Limnological Station was focused on studies of the natural resources of the lake. Around 1500 kinds of animals inhabit the lake and 1100 plants constitute its unique flora. About a third of some 52 kinds of fish in Baikal have economic significance, including, significantly, omul, white fish, sturgeon, salmon, ide (carp), roach, and pike. By the 1950s, Baikal station had more than a hundred employees, who studied Baikal's flora, fauna, and other natural resources of the lake, its hydrobiology, hydrometeorology, geology, the chemistry of the water, currents, etc. However, in order to get additional income and acquire modern equipment and several boats, some more applied studies were conducted as well.[24]

The opportunities for "application" were plenty. The industrial development of the region and the exploitation of Siberia's vast resources had been underway since the beginning of the twentieth century, but were greatly intensified after the revolution. The first priority for the region set up by the new Bolshevik state was the development of the gas and oil industry, followed by hydropower.[25] As early as 1920, the State Electrification Agency, GOELRO, commissioned a report on the potential of the Siberian rivers for hydropower. Since the 1930s, limnologists from the Baikal Limnological station had routinely conducted studies in preparation for the construction of a series of planned hydropower stations on the Angara river (Josephson 1997). WWII slowed down these developments, but in the immediate postwar years the industrial development of the region resumed with renewed energy.[26] By the mid-1950s,

[24] See the discussion of the economic imperatives of Siberian development and the ways Siberian scientific institutions have met them in different periods in Josephson (1997).
[25] For Soviet science policy in the early years of the Soviet Union see Krementsov (1997).
[26] For an analysis of the internal debates in the Soviet Union regarding alternative visions and plans for economic development from the 1920s through the early 1950s that gave rise to the nature protection agencies, see Brain (2010).

huge hydroelectric stations had been built or were under construction on all of Siberia's major rivers.

As soon as World War II was over, the Communist Party of the Soviet Union prioritized the development of Siberia as one of the most important areas for postwar economic development. In 1947, the first postwar conference on the "development of the productive forces of East Siberia" was organized in Irkutsk. Among the issues discussed was the recommendation from Moscow to local fish factories "to overfulfill yearly plans in six months." This had to be accomplished with the aid of a technological innovation – motorized drift nets. Kozhov, who had just published his second major book, *The Animal World of Lake Baikal* (1947), was invited as a local expert and he used the opportunity to openly challenge the suggestions coming from Moscow. On the basis of the data he collected during the war for his book, he prepared a report demonstrating the decline in the fish population over the previous few years. The five-year plan, Kozhov pointed out, already implied overfishing that threatened mollusks and fish. Kozhov argued that the plan had to include not just the extraction numbers, but the "measures to increase fish reserves," which had not been taken into account in the planning (Josephson 1997). The further developments threatened Baikal's environment to such an extent that overfishing was no longer the major issue. Historian Paul Josephson, in his study of the Siberian Akademgorodok, explored the following story in detail (Josephson 1997; Weiner 1999).

In the spring of 1950, the construction of Irkutsk Hydroelectric Power Station, located on the Angara river, began. By 1958, this and two other hydroelectric stations, Bratsk and Krasnoyarsk, had been successfully constructed, with the construction of Eniseisk, Ust Ilimsk, and Sayansk stations along the Angaro-Eniseisk Cascade underway. When Irkutsk Station was constructed in 1956, it raised the level of the Angara up to that of Lake Baikal and then raised the level of the lake itself one and a half meters, destroying the shoreline. As a result of the subsequent damming, the delta areas, formerly rich in fish and wildlife, were diminishing with increasing speed.

In the wake of these constructions, in 1958, the conference on "the development of the productive forces in East Siberia" had again taken place to assess the developments and set the future plans. Organized in the wake of Sputnik, the conference publicized plans for the transformation of Siberia into an important economic region. Baikal played an important role in these plans. In 1954, the State Committee of the Cellulose, Paper and Woodworking Industry of the USSR was informed that the Americans had developed the production of super-strong rayon cord, important for the aviation industry. In order to meet the US challenge, the Committee resolved to build a similar plant, and chose Lake Baikal as an ideal location. Its exceptionally pure waters with low mineral content were essential, argued the committee, for producing "super-super" cellulose cord needed for airplane tires (Rainey 1991). Another plant, for paper manufacturing, was also in the plans for Lake Baikal's "rational use." More to follow. An engineer from the Moscow Hydroelectric Design Institute, N.A. Grigorovich, made the proposal to tap Baikal's power by blasting out the mouth of the lake's outlet, the Angara river, with a 30-kiloton bomb (50 percent larger than the nuclear bomb dropped on Hiroshima). He calculated that the widening of the mouth would lower the level of Baikal by 5 meters – 4 meters more than the level of the rise of Baikal after the construction of the Irkutsk hydroelectric station – and would make the aperture of Baikal 25 meters deeper and 100 meters wider for a distance of 10 kilometers. The millions of gallons of water released would create billions of kilowatt-hours of electricity, Grigorovich reported (Zlobin 1959).

Kozhov attended the 1958 conference, prepared to address the problem of overfishing by presenting the fish industry with the facts. However, now he stood up to defend Baikal from Grigorovich's high modernist projects:

> I cannot keep quiet. Excuse me for speaking without preparation. Not only are fishermen against <detonation>, the Sovnarkhozy (regional economic organs) are also against it. Baikal is a unique gift of nature. This is the deepest lake in the world. […] but for the animal world of Baikal the surface waters have the greatest significance. Reducing Baikal by five meters will expose the entire shoreline circumference [...] and dry up the fish spawning grounds. […] Grigorovich calculated that a hundred billion kilowatt hours meant a gain of two billion rubles. [...] But the losses will also be two billion. […]We do not have the right to destroy the harmony and beauty of this unique gift of nature (Zlobin 1959).

The conference participants voted to reject both Grigorovich's project and the Baikal paper mill, and to turn Baikal into a *zapovednik* (national park) instead. This was not to happen. The construction of the paper mill and the Baikal Cellulose Combinat on the shores of Baikal was authorized.

In the same year, however, another construction began: The Academgorodok, the Siberian city of science, started the construction of its scientific research institutes. The Siberian site on the Ob Sea, a reservoir near the city of Novosibirsk, was chosen by practical idealist scientists Mikhail Lavrentiev, Sergei Sobolev, Andrei Trofimuk, and others, supported by Nikita Khrushchev, because it was so far from Moscow (Josephson 1997). The utopian vision of the Akademgorodok founders, who saw the geographical periphery as an opportunity to work without interference from the party state, proved to be an illusion. Nevertheless, Akademgorodok enjoyed much more independence than other Soviet scientific centers, and became a symbol of de-Stalinization and postwar democratization. Academgorodok scientists – biologists, economists, mathematicians, geophysicists, etc. – many of whom were directly involved in the study of Siberian natural resources, publicly opposed policies concerning the economic development of Siberia that were emanating from Moscow, backing the nascent Soviet environmental movement to preserve Lake Baikal.

Enter Vorontsov. Nikolay Nikolaevich Vorontsov, an evolutionary biologist who served as Environment Minister in the last government of the USSR under Premier Gorbachev, was born in Moscow in 1934. He graduated from Moscow University in 1955 with a diploma in Vertebrate Zoology, and pursued his doctorate studies at the Zoological Institute in Leningrad, where he received his PhD in 1963. As many other scientists aspired to find intellectual freedom and professional and personal opportunities in Siberia, Vorontsov decided to move to Akademgorodok. He found himself at the center of a vast Siberian territory, and at the center of debates over Stalinist plans for the transformation of nature in Siberia. As the academic secretary of the biological sciences division of the Siberian branch of the Academy of Sciences, Vorontsov used this position to speak up for the nascent environmental movement's campaign to protect Lake Baikal and other areas in Siberia against postwar "big science" projects (Weiner 1999; Copanna 2000; Graham 2006).

By the time Vorontsov came to Akademgorodok, the issues with Baikal had worsened. Despite the protests, the Baikal Paper and Cellulose Combinat (Baikalskii Tcelluloznyi i Bumazhnyi Kombinat) was constructed, and began its operations in 1966, dumping heavy metals, sulfur, phenols, and other pollutants into Baikal. Despite the growing body of data demonstrating the dangers of pollution that had been regularly collected and supplied by scientists, now joined by the fishery industry, the Baikal mill did not change its procedures. From 1965, Vorontsov participated in the commissions set up by the Academy of Sciences to investigate the Baikal paper mill question. The commission reviewed the available data on Baikal's environment and regularly submitted reports demonstrating the excessive abuses of the paper plant. The pleas to save Baikal went to the Party's Central Committee, and personally to Brezhnev. Brezhnev, who saw Siberian developments through the lens of economic desiderata, refused to act (Rainey 1991).

Simultaneously with his participation in the review of the GNEM proposal for the IBP, Vorontsov was actively involved in scientists' campaign for the protection of Baikal. Scientists at the Baikal Limnological Station, renamed the Limnological Institute in 1961, and its sister institution, the Biological and Geographical Institute in Irkutsk, focused their efforts on clarification of the pollution norms and procedure for measuring the impact of industrial waste on Baikal's and other lakes' biota – microbes, algae, plankton, mollusks, and fish – to determine maximum allowable concentrations (PDKs). This research was based on extended monitoring of the lake and surrounding areas. In 1970, Vorontsov delivered a report to the Academy presidium that demonstrated extensive erosion and pollution of the lake, with PDK exceeded by up to 98 times for some dangerous wastes (Josephson 1997, 183). The commission passed on the recommendation to expand the staff of the Baikal Limnological Institute, and insisted on the adoption of the pollution control procedures and equipment by the Baikal paper mill.

At that time, Vorontsov got to know Kozhov and his work very well. As Vorontsov recollected in his interview soon after being elected the first USSR Minister of the Environment in 1989,

> I stood, together with the others, to protect Baikal's environment […] but the real heroes were A. A. Trofimuk, G. I. Galazij, a long-time director of the Baikal Limnological Institute, and the veteran of Baikal studies, M. M. Kozhov. […] These were the noble fighters, uncompromising, without fear and without reproach (Uspenskaya 1989, 4).

The controversy over Baikal had generated a vast amount of data on the Baikal environment and its change. The data, however, were marshaled to serve different ends in the controversy. While the Academy commissions and local scientists – "environmentalists" – were documenting the drastic decline in the number of freshwater fish in Siberian lakes and rivers because of unencumbered industrial pollution, Gosplan (the State Planning Commission), which had appointed in 1966 an intergovernmental commission to investigate Baikal, found nothing wrong with the pollution numbers. Josephson explains why: The Gosplan Commission had close ties with the paper and defense industries, and "freely changed the PDK as needed" (Josephson 1997, 181). As a result, as the then director of the Baikal Limnological Institute Galazij said, "You can stay within accepted norms and regularly release into Baikal hundreds of tons of oil, tens of thousands of tons of mercury, huge quantities of heavy metals, and other matters" (quoted in Josephson 1997, 180).

The data were interpreted in different ways even within the Kozhov family. Olga Kozhova, who became professor and then senior researcher at the Biological and Geographical Institute, just like her father earlier on, "inherited" the monitoring system after Kozhov died in 1968. She continued and extended the data collection program, starting to collect data on chlorophyll levels and initiating the first attempts to create mathematical models of Baikal ecosystems (Breining 2011). However, as Josephson points out, Kozhova joined another side of the controversy over the Baikal Cellulose Combinat and the paper mill (for a discussion on Kozhova's stand on the controversy see Josephson 1997, 182-3). She served on the commissions that supported the paper industry, arguing that the data indicating environmental change could be attributed to existing temporary fluctuations of a hydrometeorological or hydrobiological nature, or to scientific uncertainties. Along with many other scientists in the 1970s, she shared a faith in the "self-regulating" and "self-cleaning" capacities of the natural ecosystems, interpreting, unlike her father, the dramatic loss of up to 50 percent of all plankton in Baikal as showing the dynamic character of plankton and fish populations (ibid). She later changed her views, though, and joined forces with those who defended Baikal from industrial encroachment, providing crucial support for the first edition of the 1999 "law for the protection of Lake Baikal," backing it with the data the family had collected (Breining 2011).

The controversy over the abuse of nature in the Baikal region fueled what might be called a “battle of data.” While the Gosplan commission claimed that Baikal’s nature change was *normal*, marshaling the data through changing the norm itself, e.g. the PDK, Kozhova claimed the documented environmental change was simply *natural*, explained by the dynamic character of the self-regulating ecosystems.

In the 1980s, when Baikal became part of the GEMS global net of monitoring stations, yet another interpretation of the data had emerged. The Report of the Environmental and Climate Monitoring Laboratory, set up under the auspices of the State Committee on Hydrometeorology and Control of the Environment (Goskomgidromet) as part of the Global System of Environmental Monitoring (GEMS), listed Baikal among Soviet baseline GEMS stations (Analiticheskii obzor 1988, 35). However, the conclusion the laboratory had arrived at was not what Kozhov had thought his data had shown. The report bluntly stated that:

> Long-term observations of the state of the pollution of the rivers and lakes in the baseline regions of the East European countries – members of the Council for Mutual Economic Assistance (CMEA) – show that the level of pollution by such pollutants as metals, benzopiren and chlororganic pesticides corresponds to the global level of pollution and does not differ much from that in the USA or the countries of Western Europe. […] Data obtained on the territory of the USSR show that the pollution level of Lake Baikal […] differs little from the sediment pollution in the baseline regions of Western Europe and North America (Analiticheskii obzor 1988, 35).

Neither “normal” nor “natural,” Baikal’s nature change was proclaimed to be *average* – just like in other countries.

The Kozhov family data continue to live their own life. Recently, the data were made available at the NCEAS Data Repository at the initiative of Kozhov’s granddaughter Lyubov Izmest’eva, a professor at Irkutsk University and a researcher at Baikal institutes like her mother and grandfather (Izmest’eva 2006). When data were analyzed jointly by a team of scientists from NCEAS and from Irkutsk University, a deputy director of NCEAS, Stephanie Hampton, noted in her interview with the NYT reporter that Kozhov’s “data correlate well” with records of ecological phenomena elsewhere – “You could not make up something like this” (Dean 2008).

4. Conclusion

Soviet environmental activism did not leave a Russian equivalent to Rachel Carson’s *Silent Spring*, although the campaign to save Baikal had the potential to produce one. A small but influential group of Russian writers joined scientists in the battle for Baikal. When the call for environmental policy fell on deaf ears, the writers attempted to organize a public debate on a small scale, launching a weekly series in a literary journal, *Literaturnaya Gazeta*, debating the nature transformation plans, for example opposing the Grigorovich proposal to blast the outlet of Baikal wide open (Taurin 1959).[27] These writers saw Kozhov as a bridge between literary circles and the scientific community. Alexander Tvardovsky, the editor of the journal *Novyj Mir*, which launched Solzhenitsyn as a writer, repeatedly invited Kozhov to write for *Novyi Mir*, presenting in a not too specialized way the data on Baikal pollution and the growing dangers that the Soviet economic strategies, prioritizing utilitarian desiderata, posed for Baikal. Kozhov turned down Tvardovsky's invitation to tell his story to the broader public, and lost the opportunity to become a "Russian Rachel Carson" for Baikal. A modest man, Kozhov preferred to fight the battle in his way: by collecting data.

The global planning of the environmental monitoring system in the 1960s and 1970s was pursued in parallel with the local effort in the environmental monitoring of Lake Baikal. These were parallel developments, since both were shaped by the controversies over anthropogenic abuses of nature. These parallel lines of global and local stories met at one point, only to produce, as in Lobachevsky's non-Euclidian geometry of a curved space-time, a somewhat "curved" representation of Baikal monitoring data. Neither visible nor terribly effective, Soviet environmental activism left, nevertheless, a critical legacy – meticulously collected and preserved data detailing the environmental changes in the places most affected by disastrous Soviet environmental policies, such as Lake Baikal.

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[27] For a discussion on the writers' involvement in the campaign to save Lake Baikal see Rainey (1991); Weiner (1999).

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